

An iCALL approach to morphophonemic training for Irish using speech technology

Neasa Ní Chiaráin¹ and Ailbhe Ní Chasaide²

Abstract. A key benefit in intelligent Computer Assisted Language Learning (iCALL) is that it allows complex linguistic phenomena to be incorporated into digital learning platforms, either for the autonomous learner or to complement classroom teaching. The present paper describes (1) complex phonological/morphophonemic alternations of Irish, which are problematic for many learners; (2) an iCALL platform, *An Scéalaí*, which uses speech technology and Natural Language Processing (NLP) prompts to train writing and aural skills – in this paper the target is the morphophonemic alternations of (1); and (3) a perception experiment to guide how the platform might be used for prompt-based self-correction. The perception experiment has been carried out using newly built synthetic voices based on deep neural network technology.

Keywords: iCALL, text-to-speech synthesis, Irish, phonological contrasts, morphophonemics, linguistic complexity.

1. Introduction

Learning a second language may entail dealing with complex linguistic phenomena which have no parallel in the first language. In the case of Irish, there are complex phonological and morphophonological aspects which present numerous difficulties to learners and which are not common to other ‘familiar’ Western European languages. As detailed below, inadequate mastery of these structural elements impacts greatly on written accuracy as well as pronunciation accuracy.

1. Trinity College Dublin, Dublin, Ireland; neasa.nichiarain@tcd.ie; <https://orcid.org/0000-0002-4669-5667>

2. Trinity College Dublin, Dublin, Ireland; anichsid@tcd.ie

How to cite this article: Ní Chiaráin, N., & Ní Chasaide, A. (2019). An iCALL approach to morphophonemic training for Irish using speech technology. In F. Meunier, J. Van de Vyver, L. Bradley & S. Thouéšny (Eds), *CALL and complexity – short papers from EUROCALL 2019* (pp. 314-320). Research-publishing.net. <https://doi.org/10.14705/rpnet.2019.38.1029>

In this paper, we are concerned with how an iCALL platform can serve as a vehicle for the training of these specific language skills, training not only the phonological and morphophonological processes, but also their realisation in the written language. The platform under development, *An Scéalaí* (the storyteller), uses speech technology – here text-to-speech (TTS) synthesis – to ensure that all four language skills are nurtured together and that the spoken language is at the heart of all learning activities. It functions as an intelligent tutor: the learner first composes a piece of text and is then guided through prompts, both auditory and textual, with the goal of enabling self-correction. Being speech-based, it seems ideally suited to the training of the morphophonological aspects of the language, which are the focus here. This platform incorporates NLP capacities where the prompts being offered to the learner are based on linguistic-phonetic knowledge, drawing in many cases on linguistic modules that are core components of the TTS system. It also draws on pre-existing resources such as online dictionaries and spelling and grammar checkers (Scannell, 2013).

2. Complex phonological and morphophonemic targets

The sound system of Irish contrasts palatalised and velarised pairs of consonants. For example, ‘león’ /lʲ oː nʲ/ (*lion*) and ‘lón’ /lʲ oː nʲ/ (*lunch*). This contrast is of fundamental importance for lexical differentiation but also for grammatical differentiation, for example the morphophonological alternation of velarised and palatalised final consonants is used to signal number and case (e.g. *bád* /bʲ aː dʲ/ (*boat*), *báid* (/bʲ aː dʲ/ (*boat: plural and genitive case*)). In this paper we focus on noun number.

The orthographic conventions of Irish are rather complex in how the contrast is signalled. The consonant is not marked, but the palatalisation-velarisation (*slender* and *broad* in vernacular parlance) difference is shown by the adjacent vowel letter used – front vowel letters (i, e) marking palatalisation and back vowel letters (a, o, u) marking velarisation. A spelling rule, ‘*broad-with-broad and slender-with-slender*’, dictates that the vowel letters before and after a consonant letter have to come from the same set, front or back.

Unfortunately, the phonic basis of the spelling rule is not appreciated by learners or by most teachers. Rather, the consonantal difference is entirely missed (at least consciously) by learners. The spelling rule is rather vacuous and understood to be something simply to do with the visual written forms, rather than a basic rule of pronunciation.

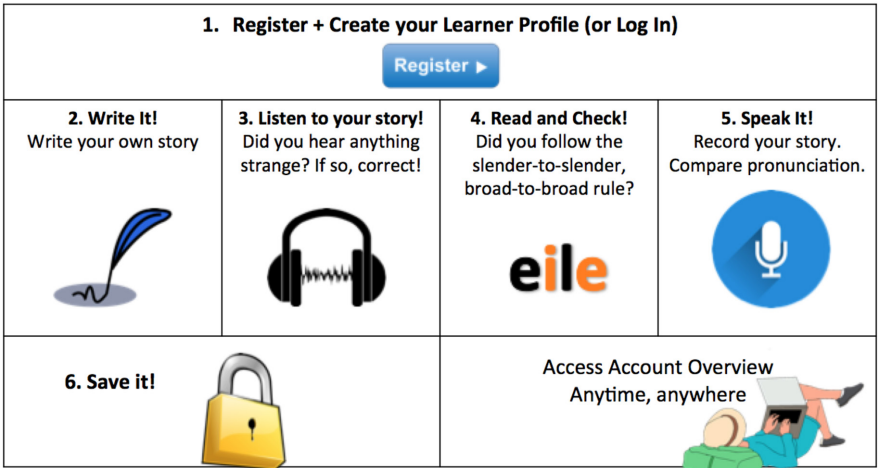
3. An Scéalaí as a personal intelligent tutor

An Scéalaí works as a personalised intelligent platform (see Ní Chiaráin & Ní Chasaide, 2018). After initial registration and personal profile creation, the learner writes a story (Figure 1).

Figure 1. *An Scéalaí* user interface where learners compose their story



Figure 2. How to use the platform



Learners are then directed to follow specific steps to improve the piece (see 2-5 in [Figure 2](#) above) :

- write a story;
- listen back to the story (using TTS), and correct;
- read back over the story (using NLP prompts), and correct; and
- record yourself reading the story aloud (compare recording with native-like TTS).

3.1. Present problem

The focus here is on the morphophonemic alternation of palatalised versus velarised consonants to differentiate singular and plural. However, when an error appears, it is not necessarily obvious whether this is the result of (1) a simple typo, (2) a lack of discrimination (phonological awareness) on the part of the learner (do they *hear* the difference?), or (3) a lack of understanding of the grammatical role in signalling plurals. The prompting process can help illuminate which of the above is the case for a particular learner in a particular instance.

The second step in *An Scéalaí* requires learners to listen to their written text spoken by the TTS voice. This proof listening step may be all that is required for proficient learners in that they can simply hear errors because they ‘sound wrong’. However, if the targeted errors fail to be corrected, the learner is then prompted in two ways. First, a chatbot intervenes and points out that they have failed to indicate (in this case) the plural form. If this does not suffice, a text version is also provided and the learner’s written text is highlighted with colour coding that signals precisely where the rule has been contravened. For example, the learner writes « Tá **na bád** amuigh ar an bhfarraige » (*The *boat (definite article plural + noun singular) are at sea*). (Note the correct version is ‘**na báid**’ (*definite article plural + noun plural*)).

- Step 1, the learner listens and self corrects; if the error is missed they move on to Step 2.
- Step 2, the chatbot says “An bád amháin nó níos mó na bád amháin atá i gceist agat?” (*Are you referring to one or to more than one boat?*); if the error is missed the learner moves on to Step 3.

- Step 3, the text feedback says “Tá *na* bá**d** amuigh ar an bhfarraige” (red/italics (slender indicator) should match red and not blue/bold (broad indicator)).

3.2. Justifying use of prompt

The goal is to use auditory and visual feedback to reinforce the phonological contrast and train its morphophonological (grammatical) usage. However, in order to examine to what extent the prompts are effectively used in the learning process, certain tests are required, as follows:

(1) Pre-test the synthetic voices:

- Does the TTS adequately produce the contrast so it is clearly audible (test proficient speakers)?

(2) Learner Phonological Awareness (PA) test:

- Is the particular learner/cohort aware of (discriminating) the consonantal contrast?

(3) Efficacy of prompting test:

- Auditory prompting: can the TTS prompting (listening only) lead to the ability to hear the error (when the slender consonant is not produced)? This suggests the PA is OK, and that the grammatical rule is understood.
- Written prompting: is it only the written prompt that leads to correction (as a vacuous spelling rule)? This suggests the PA is not OK, and the grammatical rule is meaningless as it involves only the written ‘correct’ form, and lacks phonic basis. There is a need to go back to PA training.

The following section describes a perception experiment to test (1) above.

4. Perception experiment

This experiment is designed to ascertain that the TTS voice is producing sufficiently clear differentiation of the contrast in the context where plurality is expressed. The experimental setup involved:

- materials in which a set of words was compiled to cover all final velarised consonants (and many final consonant clusters) which should yield palatalised counterparts in plural forms (all first declension masculine nouns, n=38); and
- participants (n=25) were presented with a survey interface (*Limesurvey*) where they hear either the singular or plural form of the noun and are asked to transcribe the word they hear. In the event that they hear the difference but misspell the answer they are also asked to specify whether the form they heard was singular or plural. They are further asked to rate the ease with which each item was judged (see results in [Figure 3](#)). Before the task begins, they enter their biographical information and level of Irish.

The experiment was advertised to proficient speakers of Irish via Twitter and was carried out online. The first 25 responses are analysed for this paper.

5. Results

Results were overwhelmingly positive. The majority of transcriptions were accurate. Unsurprisingly, the items deemed most difficult were those where very few instances exist in the language, i.e. finals in -b/ and -f/ ([Figure 3](#)).

Figure 3. Limesurvey responses displaying one to eight of 25 results for final consonant ‘g’ in ‘clo(i)g’ (*clock(s)*) where participants transcribed the TTS output and specified it was ‘uatha’ (*singular*) or ‘iolra’ (*plural*)

Déan trascriobh ar an bhfocal ...	An san uimhir uatha nó san uim...	Bhí sé...
<input type="text"/>	<input type="text"/>	<input type="text"/>
spoonse		
clog	Uatha (an...) [A1]	An-éasca le tuiscint [A2]
Clog	Uatha (an...) [A1]	An-éasca le tuiscint [A2]
clog	Uatha (an...) [A1]	Réasúnta soiléir le tuiscint [A4]
clog	Uatha (an...) [A1]	An-éasca le tuiscint [A2]
Clog	Uatha (an...) [A1]	Éasca le tuiscint [A3]
clog	Uatha (an...) [A1]	Éasca le tuiscint [A3]
Clog	Uatha (an...) [A1]	Réasúnta soiléir le tuiscint [A4]
clog	Uatha (an...) [A1]	Éasca le tuiscint [A3]

Déan trascriobh ar an bhfocal ...	An san uimhir uatha nó san uim...	Bhí sé...
<div>response</div>		
cloig	loira (na...) [A2]	An-éasca le tuiscint [A2]
Cloig	loira (na...) [A2]	An-éasca le tuiscint [A2]
cloig	loira (na...) [A2]	Éasca le tuiscint [A3]
cloig	loira (na...) [A2]	Éasca le tuiscint [A3]
Cloig	loira (na...) [A2]	Réasúnta soiléir le tuiscint [A4]
cloig	loira (na...) [A2]	Éasca le tuiscint [A3]
Cloig	loira (na...) [A2]	Éasca le tuiscint [A3]
cloig	loira (na...) [A2]	An-éasca le tuiscint [A2]

6. Conclusion

This experiment eliminates one fundamental source of uncertainty that could arise from prompting this morphophonological process of Irish. Since the participants successfully transcribed the prompts, it is clear that the phonological distinction is robustly carried in the synthetic output. Current research is directed at the second and third steps outlined in the section above.

7. Acknowledgement

This research is funded by the Department of Culture, Heritage, and the Gaeltacht, Government of Ireland (ABAIR project).

References

Ní Chiaráin, N., & Ní Chasaide, A. (2018). An Scéalai: synthetic voices for autonomous learning. In P. Taalas, J. Jalkanen, L. Bradley & S. Thouëсны (Eds), *Future-proof CALL: language learning as exploration and encounters – short papers from EUROCALL 2018* (pp. 230-235). Research-publishing.net. <https://doi.org/10.14705/rpnet.2018.26.842>

Scannell, K. (2013). An Gramadóir: an open source grammar checking engine, Version 0.70. <https://cadhan.com/gramadoir/>

Published by Research-publishing.net, a not-for-profit association
Contact: info@research-publishing.net

© 2019 by Editors (collective work)
© 2019 by Authors (individual work)

CALL and complexity – short papers from EUROCALL 2019
Edited by Fanny Meunier, Julie Van de Vyver, Linda Bradley, and Sylvie Thouësny

Publication date: 2019/12/09

Rights: the whole volume is published under the Attribution-NonCommercial-NoDerivatives International (CC BY-NC-ND) licence; **individual articles may have a different licence.** Under the CC BY-NC-ND licence, the volume is freely available online (<https://doi.org/10.14705/rpnet.2019.38.9782490057542>) for anybody to read, download, copy, and redistribute provided that the author(s), editorial team, and publisher are properly cited. Commercial use and derivative works are, however, not permitted.

Disclaimer: Research-publishing.net does not take any responsibility for the content of the pages written by the authors of this book. The authors have recognised that the work described was not published before, or that it was not under consideration for publication elsewhere. While the information in this book is believed to be true and accurate on the date of its going to press, neither the editorial team nor the publisher can accept any legal responsibility for any errors or omissions. The publisher makes no warranty, expressed or implied, with respect to the material contained herein. While Research-publishing.net is committed to publishing works of integrity, the words are the authors' alone.

Trademark notice: product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Copyrighted material: every effort has been made by the editorial team to trace copyright holders and to obtain their permission for the use of copyrighted material in this book. In the event of errors or omissions, please notify the publisher of any corrections that will need to be incorporated in future editions of this book.

Typeset by Research-publishing.net
Cover theme by © 2019 Frédéric Verolleman
Cover layout by © 2019 Raphaël Savina (raphael@savina.net)

Fonts used are licensed under a SIL Open Font License

ISBN13: 978-2-490057-54-2 (Ebook, PDF, colour)

ISBN13: 978-2-490057-55-9 (Ebook, EPUB, colour)

ISBN13: 978-2-490057-53-5 (Paperback - Print on demand, black and white)

Print on demand technology is a high-quality, innovative and ecological printing method; with which the book is never 'out of stock' or 'out of print'.

British Library Cataloguing-in-Publication Data.
A cataloguing record for this book is available from the British Library.

Legal deposit, France: Bibliothèque Nationale de France - Dépôt légal: décembre 2019.